

## Abstract

Heavy quarks are mostly produced through initial hard scatterings at RHIC energies and they carry clean information of sQGP medium dynamics. Heavy flavor triggered correlation offers a unique insight into early interaction dynamics. Investigations of heavy quark production and correlation mechanisms in proton-proton collisions are of great importance and interest as a perturbative QCD (pQCD) test and baseline measurement for heavy-ion collisions. This poster reports the new STAR measurements of heavy flavor triggered correlations in p+p collisions at center-of-mass energy of 500 GeV using D mesons. Azimuthal angular correlation distributions between trigger D mesons and associated charged hadrons (D-h) as well as anti-D mesons (D-bar) are measured in p+p collisions at center-of-mass energy of 500 GeV for the first time. These results are compared with pQCD calculations to improve the understanding of charm quark production in elementary hadron collisions.

## Physics Motivations

### Heavy flavor azimuthal correlations in heavy-ion collisions

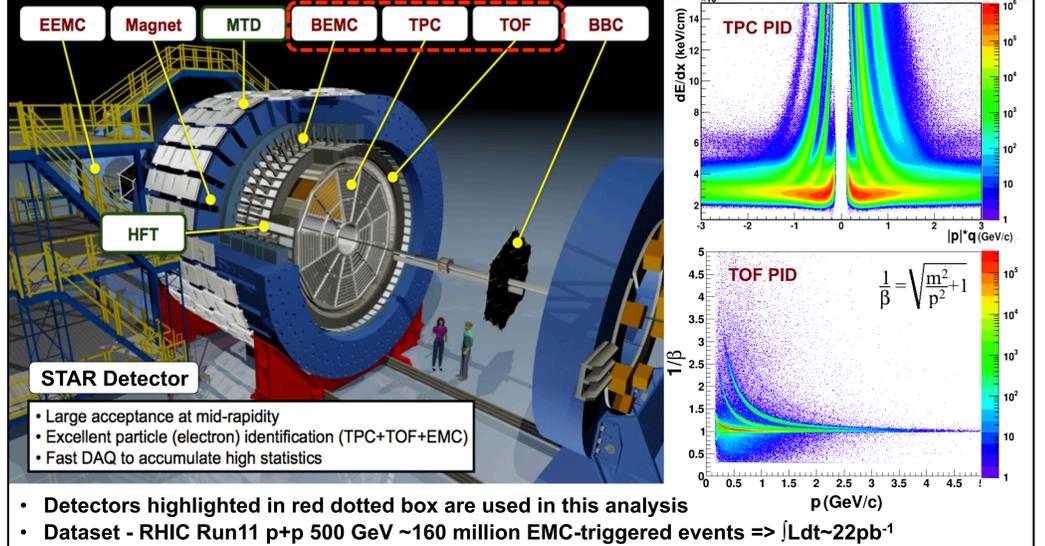
- Heavy quarks are pre-dominantly produced via hard scatterings in the initial phase of the collision
- They experience the full evolution of the system, losing energy while interacting with the medium
- Energy loss via gluon radiation predicted to be different for gluons, light quarks and heavy quarks:  $\Delta E_g > \Delta E_{(u,d,s)} > \Delta E_c > \Delta E_b$

### Heavy flavor triggered correlations in p+p collision

- Important tests of pQCD predictions (constraints on theoretical calculations) and baseline measurement for heavy ion collisions
- Comparison with di-hadron correlation to investigate heavy/light flavor jet fragmentations in p+p interactions

References *Phys. Rev. Lett.* 111.102301(2013)  
*Phys. Rev. Lett.* 100.152301(2008)

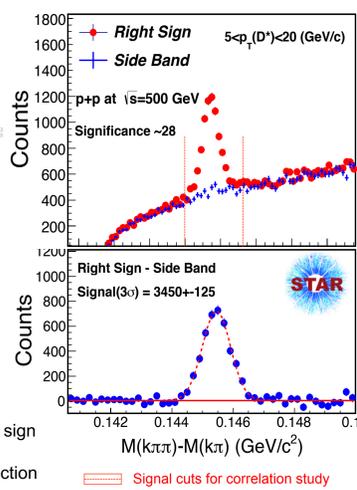
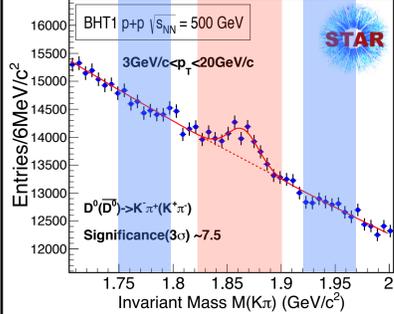
## Experimental Setup



## Analysis Method

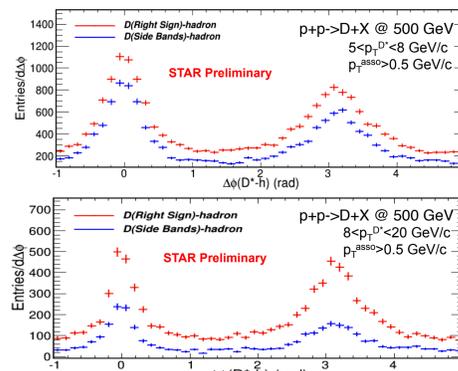
### D-meson reconstruction via hadronic decay channels

Decay Channel	Branching Ratio
$D^0 \rightarrow K^- \pi^+$	~3.89%
$D^+ \rightarrow D^0 \pi^+$	~67.7%



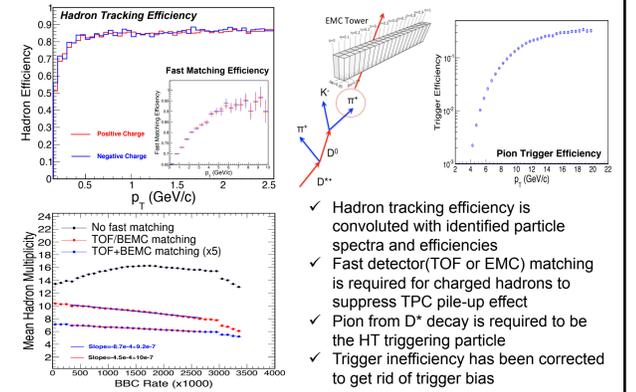
- K- $\pi$  pairs within red region are selected as right sign and blue regions are selected as side band  $D^0$  mesons for  $D^*$  signal and background reconstruction

### D\*-hadron Azimuthal Correlations



- Triggered  $D^*$  meson candidates are correlated with charged tracks produced in the same event (decay daughters excluded)
- Azimuthal correlation due to side-band background under the  $D^*$ -meson signal peak (3 $\sigma$ ) is subtracted from total correlations

### Efficiency correction and Pile-up control

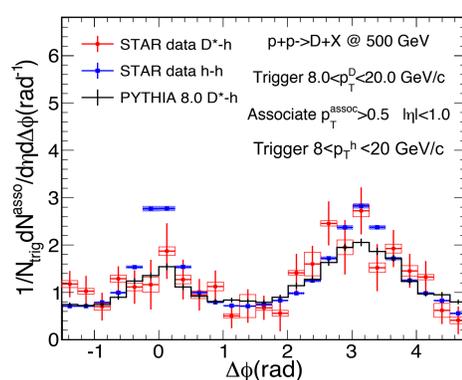
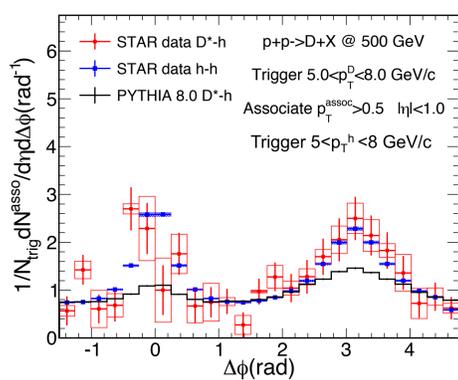


- Hadron tracking efficiency is convoluted with identified particle spectra and efficiencies
- Fast detector (TOF or EMC) matching is required for charged hadrons to suppress TPC pile-up effect
- Pion from  $D^*$  decay is required to be the HT triggering particle
- Trigger inefficiency has been corrected to get rid of trigger bias

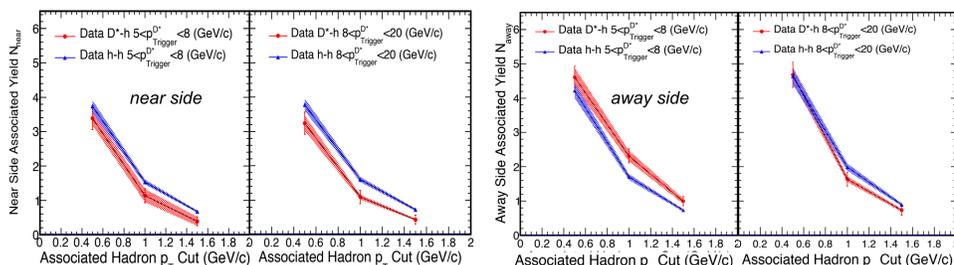
#### Systematic Uncertainties (main sources)

- D-meson yield uncertainty and uncertainties from background subtraction
- Tracking/Trigger efficiency uncertainties

## Measurement of $D^+$ -h correlation in p+p at 500 GeV



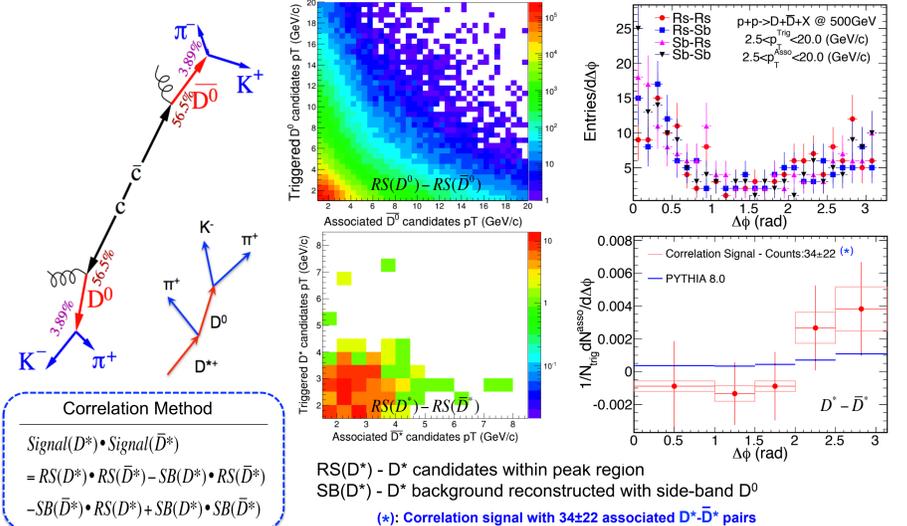
- First measurement of  $D^+$ -hadron correlation in p+p collisions at 500 GeV
- Comparison with hadron-hadron correlation and D-hadron correlation results obtained from PYTHIA simulation study (version 8.0).



- Near Side / Away side yield extracted in comparison with di-hadron correlations (baseline included)

$$f(\Delta\phi) = C + \frac{Y_{NS}}{\sqrt{2\pi}\sigma_{NS}} \exp\left(-\frac{(\Delta\phi)^2}{2\sigma_{NS}^2}\right) + \frac{Y_{AS}}{\sqrt{2\pi}\sigma_{AS}} \exp\left(-\frac{(\Delta\phi)^2}{2\sigma_{AS}^2}\right)$$

## Measurement of $D-\bar{D}$ correlation in p+p at 500 GeV



#### Correlation Method

$$\text{Signal}(D^*) \cdot \text{Signal}(\bar{D}^*) = RS(D^*) \cdot RS(\bar{D}^*) - SB(D^*) \cdot SB(\bar{D}^*)$$

- $RS(D^*)$  -  $D^*$  candidates within peak region
- $SB(D^*)$  -  $D^*$  background reconstructed with side-band  $D^0$

## Summary and Outlook

- First measurement of D-hadron azimuthal correlations in p+p collisions at center of mass energy of 500 GeV with the STAR detector is reported.
- Results of  $D^+$ -hadron correlation at  $8 < p_T^{D^+} < 20 \text{ GeV}/c$  are in agreement with PYTHIA results within statistical and systematic uncertainties. PYTHIA underestimate associated yield on both near and away side at  $5 < p_T^{D^+} < 8 \text{ GeV}/c$ .
- $D^+$ -hadron correlation shows similar trend as di-hadron correlation in the same triggered  $p_T$  region. Away side associated yield of  $D^+$ -hadron is comparable with di-hadron correlation.
- D-D(bar) correlation is firstly measured in p+p collisions at 500 GeV. Correlation signal is low in significance due to lack of statistics and results are consistent with PYTHIA within large statistical uncertainties.
- Future data with improved D-meson S/B ratio from STAR Heavy Flavor Tracker will be prospective for the measurements of D-hadron correlation and D-D(bar) correlation in Au+Au collisions